

12 **EUROPEAN PATENT APPLICATION**

21 Application number: 89122681.3

51 Int. Cl.⁵: **H04L 12/40, H04L 29/02**

22 Date of filing: 08.12.89

30 Priority: 09.12.88 JP 310100/88

43 Date of publication of application:
13.06.90 Bulletin 90/24

84 Designated Contracting States:
DE FR GB

71 Applicant: **FUJITSU LIMITED**
1015, Kamikodanaka Nakahara-ku
Kawasaki-shi Kanagawa 211(JP)

72 Inventor: **Tezuka, Koji**
Fujitsu Dai 12 Nakahararyo 339-1,
Shimokodanaka
Nakahara-ku Kawasaki-shi Kanagawa 211(JP)
Inventor: **Shinomiya, Tomohiro**
Coopo Hai Brijji 102 131-4, Imainishimachi

Nakahara-ku Kawasaki-shi Kanagawa 211(JP)

Inventor: **Amemiya, Shigeo**
1-30-3-306, Kaminomiya Tsurumi-ku
Yokohama-shi
Kanagawa 230(JP)

Inventor: **Iguchi, Kazuo**
2582-8, Imajuku-cho Asahi-ku
Yokohama-shi Kanagawa 241(JP)

Inventor: **Soejima, Tetsuo**
1-67-6-3, Suwa
Tama-shi Tokyo 206(JP)

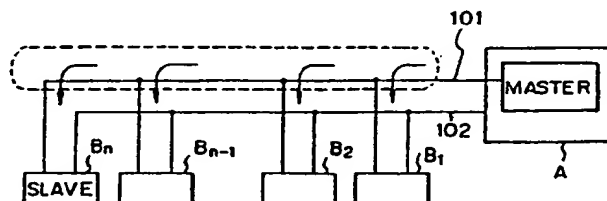
74 Representative: **Lehn, Werner, Dipl.-Ing. et al**
Hoffmann, Eitle & Partner Patentanwälte
Arabellastrasse 4
D-8000 München 81(DE)

54 **Polling communication system with priority control.**

57 A communication system containing: a master station (A), a plurality of slave stations (B1, B2, ... Bn-1, Bn) each for communicating with the above master station (A), a two-way transmission line (101, 102) connecting the above master station (A) and the above plurality of slave stations (B1, B2, ... Bn-1, Bn). Each of the above slave stations (B1, B2, ... Bn-1, Bn) sends a request for a further communication with the above master station (A), to the master station (A) when its own slave station is allowed to communicate with the master station (A) and its own slave station has the above request. The above master station (A) detects the request for a further communication with the above master station (A) in a signal sent from a slave station, and memorizes a slave station from which a request for a further communication with the master station (A) is detected, until an allowance is sent to the slave station from the master station (A) corresponding to the memorizing of the slave station. The master station (A) has a cyclic address pointer (54) which points out an address of a next one of the above slave stations (B1, B2, ... Bn-1, Bn) in a cyclic order when

no slave station is memorized in the master station (A). The master station (A) outputs an allowance to communicate with the master station (A): to a slave station which is memorized in the master station (A); or to a slave station the address of which is pointed out by the above cyclic address pointer (54) when no request is memorized in the master station (A).

Fig. 1



BEST AVAILABLE COPY

EP 0 372 567 A2

Fig. 3

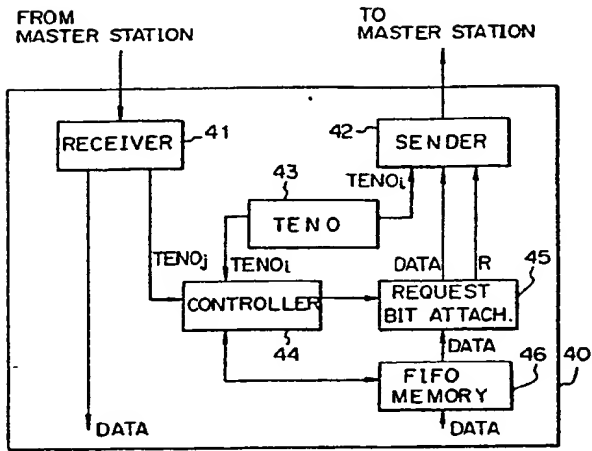
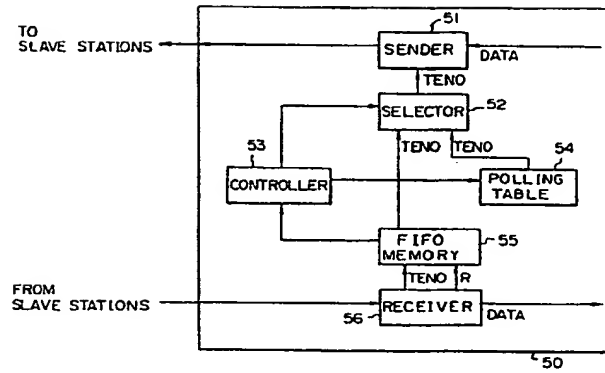


Fig. 6



POLLING COMMUNICATION SYSTEM WITH PRIORITY CONTROL

BACKGROUND OF THE INVENTION

(1) Field of the Invention

The present invention relates to a communication system containing a master station and a plurality of slave stations wherein communication between the master station and the plurality of slave stations is carried out by polling.

(2) Description of the Related Art

In a conventional communication system containing a master station and a plurality of slave stations which are usually located so far from the master station that an unignorable (round trip) delay exists in signal transmission between each slave station and the master station, the master station gives an equal allowance to communicate with the master station to each slave station in a simple cyclic order by polling.

Figure 1 shows an arrangement of a communication system between a master station and a plurality of slave stations.

The master station A and a plurality of slave stations B_1, B_2, \dots, B_{n-1} are connected by transmission lines 101 and 102 each for transmitting signals in directions from the master station A to each slave station and from each slave station to the master station, respectively.

In the above arrangement, the master station has a polling table as shown in figure 2, which points to the addresses of the slave stations in a cyclic order, and each address which is pointed to is renewed after each polling operation. The master station polls (gives an allowance to communicate with the master station) equally each slave station in a simple cyclic order using the polling table.

The cycle of the above polling is determined so that a communication with each slave station can be completed without an interference with a communication with an other slave station.

In the conventional communication system in the arrangement of Fig.1, it is not considered whether or not each slave station has a request for a communication with the master station, or how much data is requested to be transmitted between the master station and each slave station at the moment of polling.

Therefore, the polling is equally carried out for each slave station regardless of the status of requests as above, and a total efficiency of communications between the master station and the plural-

ity of slave stations is low due to polling of a slave station which does not have a request for a communication with the master station, and a possible occurrence of waiting for an allowance of a communication with the master station, in a slave station.

SUMMARY OF THE INVENTION

An object of the present invention is to provide a communication system between a master station and a plurality of slave stations, wherein communications are totally carried out with high efficiency.

Another object of the present invention is to provide a communication system between a master station and a plurality of slave stations, wherein, an exclusive use of the communication system by a slave station, is prevented.

According to the first aspect of the present invention, there is provided a communication system containing: a master station, a plurality of slave stations each for communicating with the above master station, a two-way transmission line connecting the above master station and the above plurality of slave stations. Each of the above slave stations includes: a request sending circuit for sending a request for a further communication with the above master station, to the master station when its own slave station is allowed to communicate with the master station and its own slave station has the above request. The above master station includes, a request detecting circuit, a request memorizing circuit, a cyclic address pointer, and a select control circuit. The above request detecting circuit detects a request for a further communication with the above master station in a signal sent from a slave station. The above request memorizing circuit memorizes a slave station from which a request for a further communication with the master station is detected, until an allowance is sent to the slave station from the master station corresponding to the memorizing of the slave station. The above cyclic address pointer points out an address of a next one of the above slave stations in a cyclic order when no slave station is memorized in the above request memorizing circuit. The above select control circuit outputs an allowance to communicate with the master station: to a slave station which is read out from the above request memorizing circuit when at least one slave station is memorized in the above request memorizing circuit, or to a slave station the address of which is pointed out by the above cyclic address pointer circuit when no request is memorized in the

above request memorizing circuit.

According to the second aspect of the present invention, there is provided a communication system containing: a master station, a plurality of slave stations each for communicating with the above master station, a two-way transmission line connecting between the above master station and the above plurality of slave stations. Each of the above slave stations includes: a request sending circuit for sending a request for a further communication with the above master station, to the master station when its own slave station is allowed to communicate with the master station and its own slave station has the above request. The above master station includes, a request detecting circuit, a request memorizing circuit, a counter circuit, a cyclic address pointing circuit, and a select control circuit. The above request detecting circuit detects a request for a further communication with the above master station in a signal sent from a slave station. The above request memorizing circuit memorizes a slave station from which a request for a further communication with the master station is detected, until an allowance is sent to the slave station from the master station corresponding to the memorizing of the slave station. The above counter circuit counts a number of successive outputs of allowances to communicate with the master station, which have been given to the slave stations which are memorized in said request memorizing circuit, and is reset when the number becomes equal to a predetermined number. The above cyclic address pointer points out an address of a next one of said slave stations in a cyclic order when no slave station is memorized in said request memorizing circuit, or when the count in said counter circuit becomes equal to said predetermined number. The above select control circuit outputs an allowance to communicate with the master station to a slave station which is read out from said said request memorizing circuit when at least one slave station is memorized in said request memorizing circuit, and the count in said counter circuit is not equal to said predetermined number. Or the above select control circuit outputs an allowance to communicate with the master station to a slave station the address of which is pointed out by said cyclic address pointer circuit when no request is memorized in said request memorizing circuit, or when the count in said counter circuit is equal to said predetermined number.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

Figure 1 shows an arrangement of a commu-

nication system containing a master station and a plurality of slave stations;

Figure 2 shows an example of a polling table;

Figure 3 shows the construction of a slave station in the first embodiment of the present invention;

Figures 4A and 4B respectively show text formats of signals transmitted from the master station to the slave station, and from the slave station to the master station;

Figure 5 shows an operation of the slave station shown in Fig. 3;

Figure 6 shows the construction of a master station in the first embodiment of the present invention;

Figure 7 shows an operation of the master station shown in Fig. 6;

Figure 8 shows an example of a timing of polling from the master station and signals received from the slave stations responding to the polling;

Figures 9 and 10 show examples of realizations of the slave station and the master station of the first embodiment of the present invention;

Figure 11 shows the construction of a master station in the second embodiment of the present invention;

Figure 12 shows an operation of the master station shown in Fig. 11;

Figure 13 shows the construction of a master station in the third embodiment of the present invention;

Figure 14 shows an operation of the master station shown in Fig. 13;

Figure 15 shows the construction of a master station in the fourth embodiment of the present invention; and

Figure 16 shows an operation of the master station shown in Fig. 15.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Figure 3 shows the construction of a slave station in the first embodiment of the present invention, and Figure 6 shows the construction of a master station in the first embodiment of the present invention. The overall arrangement of the communication system is the same as the arrangement shown in Fig. 1.

In Fig. 3, reference numeral 40 denotes a slave station, 41 denotes a receiver circuit, 42 denotes a sender (transmitter) circuit, 43 denotes a register, 44 denotes a controller, 45 denotes a request bit attaching circuit, and 46 denotes a FIFO memory.

The receiver circuit 41 receives a polling signal from the master station (the construction and the operation of the master station is explained later).

The text format of the polling signal from the master station to each slave station contains a terminal number TENO (an address of the slave station) to be polled, and data which is to be sent to the slave station, as shown in Figure 4A.

When the receiver circuit 41 receives a polling signal, the receiver circuit 41 divides the content of the signal into a terminal number TENO portion and a data portion. The data portion is transferred to a portion wherein the data is processed (not shown), and the terminal number TENO portion is transferred to the controller 44.

The controller 44 compares the terminal number TENO portion in the received signal with the terminal number TENO_i of its own slave station i, which is held in the register 43. The terminal number portion TENO includes a terminal number TENO_j of the slave station j to be polled. Therefore, when an accord between the terminal number TENO_j and the terminal number TENO_i is detected, i. e., $i = j$, it is determined that its own slave station i is polled by (allowed to send data to) the master station.

When the above accord is not detected in the controller 44, no operation is carried out responding to the polling signal. Or, when the above accord is detected in the controller 44, the controller 44 controls the FIFO memory 46 to output the oldest data held therein. The FIFO memory 46 holds data which is to be sent to the master station from the slave station, and a predetermined amount of data which can be transmitted to the master station responding to one polling, i. e., a predetermined amount of data which can be transmitted to the master station in one cycle, is output when the FIFO memory 46 is controlled to output data by the controller 44 in a cycle, from the older amount of data.

The above amount of data output from the FIFO memory 46 is input into the request bit attaching circuit 45, where the request bit attaching circuit 45 is comprised of a register having a plurality of bits corresponding to the above input from the FIFO memory 46, and a request bit.

At the same time, the controller 44 determines whether or not the FIFO memory 46 holds a further amount of data to be sent to the master station, based on a signal indicating an amount of data held in the FIFO memory 46, which signal is generally output from a commercially available FIFO memory. When it is determined that an amount of data to be sent to the master station is held in the FIFO memory 46, the controller 44 sets the above request bit to "1". Or when it is determined that no data to be sent to the master station is held in the

FIFO memory 46, the controller 44 sets the above request bit to "0".

Then, the above amount of data which is input in the request bit attaching circuit 45, and the request bit are input in parallel into the sender circuit 42. At the same time, the content of the register 43, i. e., the terminal number TENO_i of its own slave station i is input into the sender circuit 42.

Using the above inputs, the sender circuit 42 makes a transmitting text format as shown in figure 4B, and sends the text to the master station through the transmission line 102.

All the above operations in the slave station are controlled by the controller 44, and the control flow of the controller 44 is shown in Figure 5.

When data (polling signal) is received in the step 8, it is determined whether or not its own slave station is polled in the step 9. If its own slave station is polled, it is determined whether or not its own slave station has further data which is to be sent to the master station (in addition to the data to be sent in the cycle, responding to the polling determined in the step 9) in the step 10. If YES is determined in the step 10, a request to access the master station for a further data transmission is set in the step 11, and then transmission of the above data with the request is carried out from the slave station to the master station in the step 12.

If NO is determined in the step 10, transmission of the above data without the request is carried out from the slave station to the master station in the step 12.

In Fig. 6, reference numeral 50 denotes a master station, 51 denotes a sender (transmitter) circuit, 52 denotes a selector, 53 denotes a controller, 54 denotes a polling table, 55 denotes a FIFO memory, and 56 denotes a receiver circuit.

The receiver circuit 56 receives data from a slave station responding to a polling signal which has been sent to the slave stations from the master station before a predetermined time. A polling signal is sent out each cycle to a slave station from the master station, and the master station receives a data signal for each cycle from a slave station to which a polling signal has been sent.

The text format of the polling signal from each slave station to the master station contains a terminal number TENO (an address of the slave station) which has been polled, a request bit, and data from the slave station, as shown in Figure 4B.

When the receiver circuit 56 receives a data signal, the receiver circuit 56 divides the content of the signal into a terminal number TENO and a request bit, and a data portion. The data portion is transferred to a portion of the master station wherein the data is processed (not shown), the terminal number TENO is applied to input terminals

of the FIFO memory 55, and the corresponding request bit is applied to a control input terminal of the FIFO memory 55.

The applied data is input into the FIFO memory 55 when the request bit is "1", or the applied data is not input into the FIFO memory 55 when the request bit is "0".

The controller 53 monitors the amount of data held in the FIFO memory 55, and controls the FIFO memory 55 to read out (read and discard) the oldest terminal number TENO held in the FIFO memory 55 when it is determined that data is held in the FIFO memory 55, based on a signal indicating an amount of data held in the FIFO memory 55 as explained before with reference to Fig. 3.

The polling table 54 contains the terminal numbers of all the slave stations in the system, and one of the terminal numbers is pointed out. When it is determined that data is not held in the FIFO memory 55, the controller 53 controls the polling table 54 to point out a next terminal number TENO among the terminal numbers in the polling table 54 according to a predetermined cyclic order.

Both the outputs of the FIFO memory 55 and the polling table 54, are applied to the selector 52. The controller 53 controls the selector 52 to select the output of the the FIFO memory 55 when it is determined that data is held in the FIFO memory 55, and controls the selector 52 to select the output of the polling table 54 when it is determined that data is not held in the FIFO memory 55.

The terminal number TENO output from the selector 52 is input into the sender circuit 51 together with polling data which is to be sent to the slave station of the terminal number TENO. The sender circuit 51 makes a text format as shown in Fig. 4A containing the terminal number TENO and the data, and sends the text to the slave stations through the transmission line 101.

All the above operations in the master station are controlled by the controller 53, and the control flow of the controller 53 is shown in Figure 7.

When data signal is received in the step 21, it is determined whether or not the request bit contained in the data signal is "1", in the step 22. If it is determined that the request bit is "1", the terminal number TENO corresponding to the request bit is input into the FIFO memory 55 in the step 23, or if it is determined that the request bit is "0", the terminal number TENO corresponding to the request bit is not input into the FIFO memory 55.

In the step 24, it is determined whether or not a terminal number TENO is memorized in the FIFO memory 55. If it is determined that a terminal number TENO is memorized in the FIFO memory 55, a terminal number TENO corresponding to the request bit is set for polling in the step 26, or if it is determined that a terminal number TENO is not

memorized in the FIFO memory 55, a terminal number TENO which is pointed out in the polling table 54 is set for polling in the step 27. The polling signal containing the terminal number TENO is sent to the slave stations in the step 28.

Figure 8 shows an example of a timing of polling from the master station and signals received from the slave stations responding to the polling in the case of the number of the slave stations is four.

In Fig. 8, TE1, TE2, TE3, and TE4 respectively denote polling signals from the master station to the slave stations B₁, B₂, B₃, and B₄, TE1R, TE2R, TE3R, and TE4R respectively denote data signals sent from the slave stations B₁, B₂, B₃ and B₄ to the master station responding to the polling signals from the master station with a request bit "1", and TE1N, TE2N, TE3N, and TE4N respectively denote data signals sent from the slave stations, B₁, B₂, B₃, and B₄ to the master station responding to the polling signals from the master station with a request bit "0".

From the time t₀ to t₃, polling signals TE1, TE2, TE3, and TE4 respectively containing terminal numbers of the slave stations B₁, B₂, B₃, and B₄, are output according to the polling table 54 because no request is received until the time t₂. The data signals responding to the above polling signals from the time t₀ to t₃, are received after a round trip delay from the time t₁ to t₄.

Requests for sending further data are included in the signals TE2R and TE3R, which are respectively received in the time t₂ from the slave station B₂, and in the time t₄ from the slave station B₃. Detecting the above requests, polling signals to the slave station B₂ and to the slave station B₃ are respectively sent out from the master station in the times t₃ and t₅.

In the time t₇, a polling signal TE1 containing a terminal number TENO1, which is pointed out in the polling table 54 after the above terminal number TENO4 in the cyclic order B₁, B₂, B₃, B₄, because the data signal received from the slave station B₄ in the time t₆ does not contain a request for sending further data.

A request for sending further data is included in the signal TE2R, which is received in the time t₈ from the slave station B₂. Detecting the request, a polling signal to the slave station B₂ is sent out from the master station in the times t₉.

Figure 9 shows an example of realization of the slave station of the first embodiment of the present invention.

In Fig. 9, reference numeral 61 denotes a multiplexer, 62 denotes a data buffer, 63 denotes a comparator, 64 denotes a register, and 65 denotes a demultiplexer.

In the construction of Fig. 9, a polling signal of

the format of Fig. 4A from the master station is divided into a terminal number TENO portion and data portion in the demultiplexer 65. The register 64 holds the terminal number of its own slave station. The terminal number TENO output from the demultiplexer 65 is compared with the terminal number held in the register 64 in the comparator 63.

The data buffer 62 functions as a FIFO memory, and outputs, when it is so controlled, an oldest amount of data held in the data buffer 62. The data buffer 62 has an output R which indicates whether or not further data is held in the data buffer 62.

When an accord between the terminal number TENO output from the demultiplexer 65 and the terminal number held in the register 64, is detected in the comparator 63, the oldest amount of data held in the data buffer 62 is output.

The above output R (which corresponds to the aforementioned request bit), the data output of the data buffer 62, and the terminal number from the register 64 are input in parallel in the multiplexer 61 to form the text format as shown in Fig. 4B, and the multiplexed signal is sent to the master station.

Figure 10 shows an example of realization of the master station of the first embodiment of the present invention.

In Fig. 10, reference numeral 71 denotes a multiplexer, 72 denotes a selector, 73 denotes a counter, and 74 denotes a demultiplexer.

In the construction of Fig. 10, a data signal of the format of Fig. 4B from a slave station is divided into a request bit R, a terminal number TENO of the slave station, and data portion in the demultiplexer 74.

The counter 73 outputs a terminal number of a slave station, and the count is incremented when an active signal is input into the control terminal of the counter. The request bit R output from the demultiplexer 74 is applied to the control terminal of the counter 73, and therefore, the count of the counter 73, i. e., the terminal number TENO, is renewed when the request bit is "0".

The terminal number output from the demultiplexer 74 and the terminal number output from the counter 73 are applied to the selector 72, and the request bit R output from the demultiplexer 74 is applied to the selector as a control signal. The selector 72 selects the terminal number output from the demultiplexer 74 when the request bit is "1", or the selector 72 selects the terminal number output from the counter 73 when the request bit is "0".

The terminal number output from the selector 72 is input into the multiplexer 71 in parallel with data for polling, are multiplexed to form the text format of Fig. 4A, and are sent to the slave stations.

Figure 11 shows the construction of a master station in the second embodiment of the present invention. In the second embodiment, the overall arrangement of the system is as shown in Fig. 1, the constructions and the operations of the slave stations are as shown in Figs. 3 and 5, and the next formats transmitted between the master station and the slave stations are as shown in Figs. 4A and 4B.

In Fig. 11, reference numeral 81 denotes a demultiplexer, 82 denotes a request table, 83 denotes a requested TENO pointer, 84 denotes a non-requested TENO pointer, 85 denotes a selector, 86 denotes a controller, and 87 denotes a multiplexer.

In the construction of Fig. 11, a data signal of the format of Fig. 4B from a slave station is divided into a request bit R, a terminal number TENO of the slave station, and data portion in the demultiplexer 81. The data portion is transferred to a portion wherein the data is processed (not shown).

The request table 82 has addresses corresponding to the plurality of slave stations in the system. The above terminal number TENO from the demultiplexer 81 is applied to the request table as an address signal, and the above request bit R is written in the address of the request table.

The requested TENO pointer 83 holds one of the addresses of the request table 82 in which request bits "1" are written. The content of the requested TENO pointer 83 is renewed by the controller 86 to a next one of the addresses of the request table 82 in which addresses "1" request bits are written, in a cyclic order.

The non-requested TENO pointer 84 holds one of the addresses of the request table 82 in which addresses "0" request bits are written. The content of the non-requested TENO pointer 84 is renewed by the controller 86 to a next one of the addresses of the request table 82 in which addresses request bits "0" are written, in a cyclic order.

Both the outputs of the requested TENO pointer 83 and the non-requested TENO pointer 84 are applied to the selector 85. The controller 86 controls the selector 85 to select the output of the requested TENO pointer 83 when at least one "1" bit is held in the request table 82, or the controller 86 controls the selector 85 to select the output of the non-requested TENO pointer 84 when no "1" bit is held in the request table 82. The selected output (terminal number TENO) of the selector 85 is supplied to the multiplexer 87 as a polling address.

All the above operations in the master station are controlled by the controller 86, and the control flow of the controller 86 is shown in Figure 12.

When a data signal is received in the step 101, the request bit contained in the received data sig-

nal is written in the address which is equal to the terminal number TENO, in the request table 82, in the step 102. In the step 103, it is determined whether or not at least one "1" bit is held in the request table 82. If it is determined that at least one "1" bit is held in the request table 82, the operation goes to the step 105, or if it is determined that no "1" bit is held in the request table 82, the operation goes to the step 108.

In the step 105, the terminal number TENO held in the requested TENO pointer 83 is selected as a polling address. Then, in the step 106, a "0" bit is written in the above address of the request table 82 which address is held in the requested TENO pointer 83, and the content of the requested TENO pointer 83 is renewed to a next one of the addresses (terminal number TENO) of the request table 82, in which addresses "1" bits are written, in the step 107.

In the step 108, the terminal number TENO held in the non-requested TENO pointer 84 is selected as a polling address. Then, the content of the non-requested TENO pointer 84 is renewed to a next one of the addresses (terminal number TENO) of the request table 82, in which addresses "0" bits are written, in the step 109.

The polling signal containing the terminal number TENO selected as above is sent to the slave stations in the step 110.

Figure 13 shows the construction of a master station in the third embodiment of the present invention. In the third embodiment, the overall arrangement of the system are as shown in Fig. 1, the constructions and the operations of the slave stations are as shown in Figs. 3 and 5, and the text formats transmitted between the master station and the slave stations are as shown in Figs. 4A and 4B.

In the construction of Fig. 13, the counter 37 is provided in addition to the construction similar to the construction of Fig. 6.

The counter 37 counts the number of successive cycles in which read-out operations in the FIFO memory 55 are carried out, i.e., the counter 37 counts the number of successive selections of the outputs of the FIFO memory 55, and a ripple carry signal from the counter 37 is supplied to the controller 33 and the count is reset when the count becomes equal to a predetermined number.

The controller 33 carries out the same operation as in the construction of Fig. 6 until the count in the counter 37 becomes equal to the above predetermined number, but when the count becomes equal to the predetermined number, the controller 33 renews the output of the polling table 54, controls the selector 52 to select the output of the polling table 54 instead of the output of the FIFO memory 55, and stops a read-out operation in the FIFO memory 55.

By the above construction of Fig. 13, the polling is prevented from being carried out successively over the predetermined number of times by one slave station, i.e., an exclusive use of the communication system by one slave station is prevented.

Figure 14 shows the control operation of the controller 33 in the construction of Fig. 13.

The only difference between the operation of Fig. 14 and Fig. 7 is that the operation of Fig. 14 is provided with a step 25 between the steps 24 and 26.

In the operation of Fig. 14, if it is determined that a terminal number TENO is memorized in the FIFO memory 55 in the step 24, it is determined whether or not the count in the counter 37 is equal to a predetermined number in the step 25. If it is determined that the count in the counter 37 is equal to the predetermined number, the operation goes to the step 27 instead of to the step 26. Or if it is determined that the count in the counter 37 is not equal to the predetermined number, the operation goes to the step 26 as in the operation of Fig. 7.

Figure 15 shows the construction of a master station in the fourth embodiment of the present invention. In the fourth embodiment, the overall arrangement of the system is as shown in Fig. 1, the constructions and the operations of the slave stations are as shown in Figs. 3 and 5, and the text formats transmitted between the master station and the slave stations are as shown in Figs. 4A and 4B.

In the construction of Fig. 15, the counter 87 is provided in addition to the construction similar to the construction of Fig. 11.

The counter 87 counts a number of successive outputs of allowances to communicate with the master station, which have been given to the slave stations which are pointed out by the requested TENO pointer 83, and a ripple carry signal from the counter 87 is supplied to the controller 33 and the counter 87 is reset when the number becomes equal to a predetermined number.

The controller 86 carries out the same operation as in the construction of Fig. 11 until the count in the counter 86 becomes equal to the above predetermined number, but when the count becomes equal to the predetermined number, the controller 86 renews the non-requested TENO pointer 84, and controls the selector 85 to select the output of the non-requested TENO pointer 84.

By the above construction of Fig. 15, the polling is prevented from being carried out successively over the predetermined number of times by slave stations from which requests have already been received in the master station, i.e., an exclusive use of the communication system by slave stations from which requests have already been

received in the master station, is prevented.

Figure 16 shows the control operation of the controller 86 in the construction of Fig. 15.

The only difference between the operation of Fig. 16 and Fig. 12 is that the operation of Fig. 16 is provided with a step 114 between the steps 113 and 115.

In the operation of Fig. 16, if it is determined that at least one "1" bit is held in the request table 82 in the step 113, it is determined whether or not the count in the counter 87 is equal to a predetermined number in the step 114. If it is determined that the count in the counter 87 is equal to the predetermined number, the operation goes to the step 108 instead of to the step 105. Or if it is determined that the count in the counter 87 is not equal to the predetermined number, the operation goes to the step 105 as in the operation of Fig. 12.

Reference signs in the claims are intended for better understanding and shall not limit the scope.

Claims

1. A communication system comprising:

a master station (A);

a plurality of slave stations (B₁, B₂, ... B_{n-1}, B_n) each for communicating with said master station (A); and

a two-way transmission line (101, 102) connecting said master station (A) and said plurality of slave stations (B₁, B₂, ... B_{n-1}, B_n);

each of said slave stations (B₁, B₂, ... B_{n-1}, B_n) comprises,

a request sending means (42, 43, 44, 45) for sending a request for a further communication with said master station (A), to the master station (A) when its own slave station is allowed to communicate with the master station (A) and its own slave station has said request;

said master station (A) comprises, a request detecting means (55, 56), a request memorizing means (55), a cyclic address pointing means (54), and a select control means (52, 53),

said request detecting means (55, 56) detects a request for a further communication with said master station (A) in a signal sent from a slave station, said request memorizing means (55) memorizes a slave station from which a request for a further communication with the master station (A) is detected, until an allowance is sent to the slave station from the master station (A) corresponding to the memorizing of the slave station,

said cyclic address pointing means (54) points out an address of a next one of said plurality of slave station (B₁, B₂, ... B_{n-1}, B_n) in a cyclic order when no slave station is memorized in said request memorizing means (55), and

said select control means (52, 53) outputs an allowance to communicate with the master station (A): to a slave station which is read out from said request memorizing means (55) when at least one slave station is memorized in said request memorizing means (55); or to a slave station the address of which is pointed out by said cyclic address pointing means (54) when no request is memorized in said request memorizing means (55).

2. A communication system comprising:

a master station (A);

a plurality of slave stations (B₁, B₂, ... B_{n-1}, B_n) each for communicating with said master station (A); and

a two-way transmission line (101, 102) connecting between said master station (A) and said plurality of slave stations (B₁, B₂, ... B_{n-1}, B_n);

each of said slave stations (B₁, B₂, ... B_{n-1}, B_n) comprises:

a request sending means (42, 43, 44, 45) for sending a request for a further communication with said master station (A), to the master station (A) when its own slave station is allowed to communicate with the master station (A) and its own slave station has said request;

said master station (A) comprises, a request detecting means (55, 56), a request memorizing means (55), a cyclic address pointing means (54), a counter means (37), and a select control means (52, 54),

said request detecting means (55, 56) detects a request for a further communication with said master station (A) in a signal sent from a slave station, said request memorizing means (55) memorizes a slave station from which a request for a further communication with the master station (A) is detected, until an allowance is sent to the slave station from the master station (A) corresponding to the memorizing of the slave station,

said counter means (37) counts a number of successive cycles in which reading-out operations of the slave stations from said request memorizing means (55) are carried out, and being reset when the number becomes equal to a predetermined number,

said cyclic address pointing means (54) points out an address of a next one of said plurality of slave stations (B₁, B₂, ... B_{n-1}, B_n) in a cyclic order when no slave station is memorized in said request memorizing means (55), or when the count in said counter means (37) becomes equal to said predetermined number,

said select control means (52, 53) outputs an allowance to communicate with the master station (A) to a slave station which is read out from said request memorizing means (55) when at least one slave station is memorized in said request memorizing means (55), and the count in said counter

means (37) is not equal to said predetermined number,
or said select control means (52, 53) outputs an allowance to communicate with the master station (A) to a slave station the address of which is pointed out by said cyclic address pointing means (54) when no request is memorized in said request memorizing means (55), or when the count in said counter means (37) is equal to said predetermined number.

3. A communication system according to claim 1 or 2, wherein said select control means (52, 53) outputs an allowance to communicate with the master station (A) to a slave station which is read out from said request memorizing means (55) in the order the request is received in the master station (A) when at least one slave station is memorized in said request memorizing means (55).

4. A communication system according to claim 1 or 2, wherein each of said slave stations (B1, B2, ... Bn-1, Bn) further comprises a self address detecting means (43, 44) for detecting the address of its own slave station in a signal received from said master station (A).

5. A communication system according to claim 4, wherein said request sending means (42, 43, 44, 45) comprises,

a request bit generating means (44, 45) for generating a request bit which indicates whether or not its own slave station has a request for a further communication with the master station (A), and
a sending means (42, 43, 44) for sending said request bit, its own address, and data to be sent to the master station (A), when its own address is detected in said address detecting means.

6. A communication system comprising:

a master station (A);

a plurality of slave station (B1, B2, ... Bn-1, Bn) each for communication with said master station (A); and

a two-way transmission line (101, 102) connecting said master station (A) and said plurality of slave stations (B1, B2, ... Bn-1, Bn);

each of said slave station (B1, B2, ... Bn-1, Bn) comprises,

a request sending means (42, 43, 44, 45) for sending a request for a further communication with said master station (A), to the master station (A) when its own slave station is allowed to communicate with the master station (A) and its own slave station has said request;

said master station (A) comprises, a request detecting means (86, 103), a request memorizing means (82), a requested address pointing means (83), a non-requested address pointing means (84), and a select control means (85, 86),

said request detecting means (86, 103) detects a request for a further communication with said mas-

ter station (A) in a signal sent from a slave station, said request memorizing means (82) memorizes a slave station from which a request for a further communication with the master station (A) is detected, until an allowance is sent to the slave station from the master station (A) corresponding to the memorizing of the slave station,

said requested address pointing means (83) points out one of the addresses of the slave stations which are memorized in said request memorizing means (82), in a predetermined order,

said non-requested address pointing means (84) points out one of the addresses of the slave stations which are not memorized in said request memorizing means (82), in a predetermined order, and

said select control means (85, 86) outputs an allowance to communicate with the master station (A): to a slave station the address of which is pointed out by said requested address pointing means (83) when at least one slave station is memorized in said request memorizing means (82); or to a slave station the address of which is pointed out by said non-requested address pointing means (84) when no request is memorized in said request memorizing means (82).

7. A communication system comprising:

a master station (A);

a plurality of slave stations (B1, B2, ... Bn-1, Bn) each for communicating with said master station (A); and

a two-way transmission line (101, 102) connecting said master station (A) and said plurality of slave stations (B1, B2, ... Bn-1, Bn);

each of said slave stations (B1, B2, ... Bn-1, Bn) comprises:

a request sending means (42, 43, 44, 45) for sending a request for a further communication with said master station (A), to the master station (A) when its own slave station is allowed to communicate with the master station (A) and its own slave station has said request;

said master station (A) comprises, a request detecting means (86, 103), a request memorizing means (82), a requested address pointing means (83), a non-requested address pointing means (84), a counter means (87), and a select control means (85, 86),

said request detecting means (86, 103) detects a request for a further communication with said master station (A) in a signal sent from a slave station, said request memorizing means (82) memorizes a slave station from which a request for a further communication with the master station (A) is detected, until an allowance is sent to the slave station from the master station (A) corresponding to the memorizing of the slave station,

said counter means (87) counts a number of suc-

cessive outputs of allowances to communicate with the master station (A), which have been given to the slave stations which are memorized in said request memorizing means (82), and being reset when the number becomes equal to a predetermined number, 5

said requested address pointing means (83) points out one of the addresses of the slave stations which are memorized in said request memorizing means (82), in a predetermined order, 10

said non-requested address pointing means (84) points out one of the addresses of the slave stations which are not memorized in said request memorizing means (82), in a predetermined order, and 15

said select control means (85, 86) outputs an allowance to communicate with the master station (A) to a slave station the address of which is pointed out by said requested address pointing means (83) when at least one slave station is memorized in said request memorizing means (82), and the count in said counter means (87) is not equal to said predetermined number, 20

or said select control means (85, 86) outputs an allowance to communicate with the master station (A) to a slave station the address of which is pointed out by said non-requested address pointing means (84) when no request is memorized in said request memorizing means (82), or when the count in said counter means (87) is equal to said predetermined number. 25 30

8. A communication system according to claim 6 or 7, wherein each of said slave stations (B1, B2, ... Bn-1, Bn) further comprises a self address detecting means (43, 44) for detecting the address of its own slave station in a signal received from said master station (A). 35

9. A communication system according to claim 8, wherein said request sending means (42, 43, 44, 45) comprises, 40

a request bit generating means (44, 45) for generating a request bit which indicates whether or not its own slave station has a request for a further communication with the master station (A), and 45

a sending means (42, 43, 44) for sending said request bit, its own address, and data to be sent to the master station (A), when its own address is detected in said address detecting means. 50

10. A communication system according to claim 6 or 7, wherein said first and second predetermined orders are each a cyclic order. 55

Fig. 1

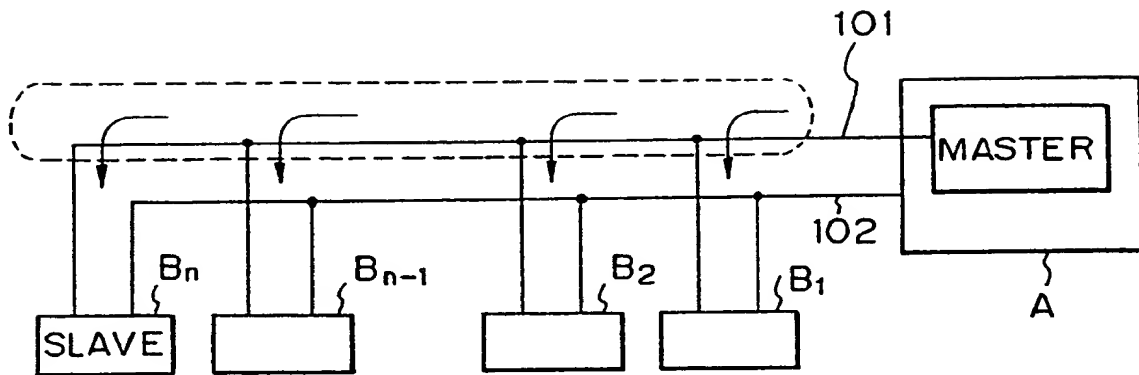


Fig. 2

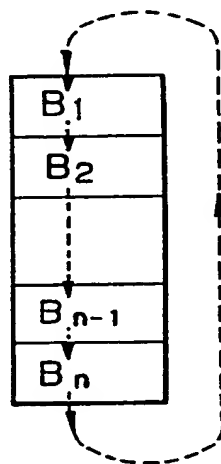


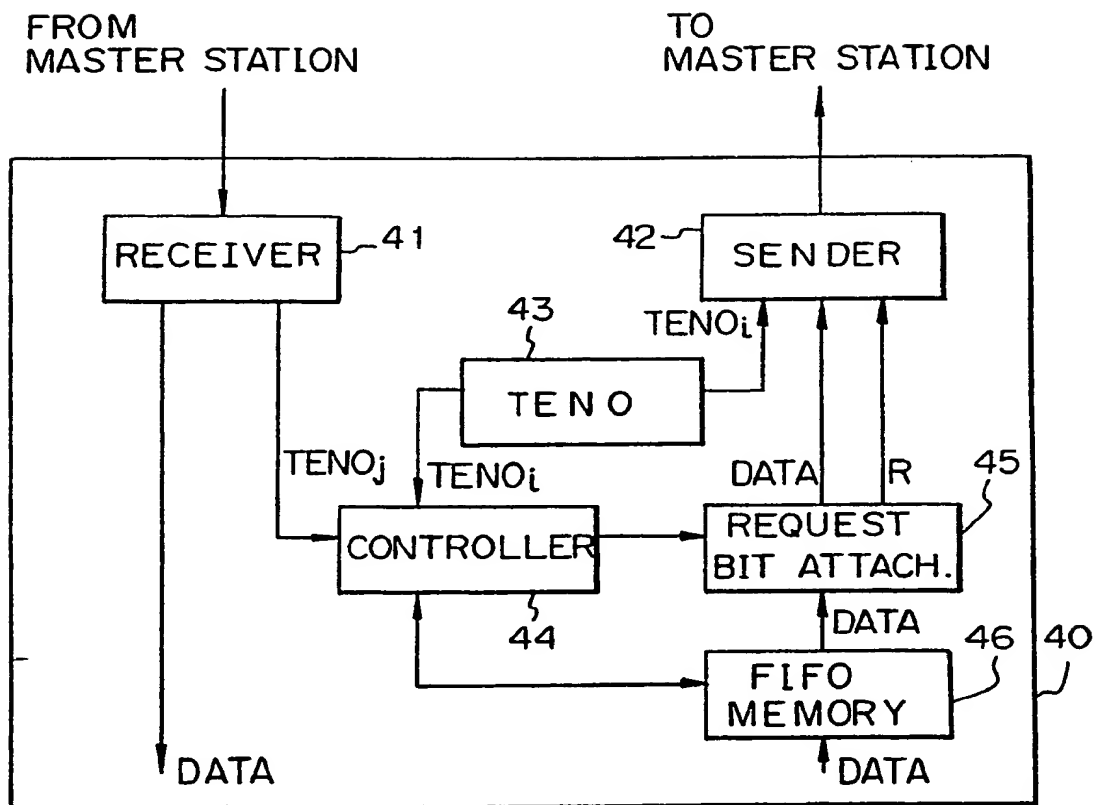
Fig. 3

Fig. 4 A



Fig. 4 B



Fig. 8

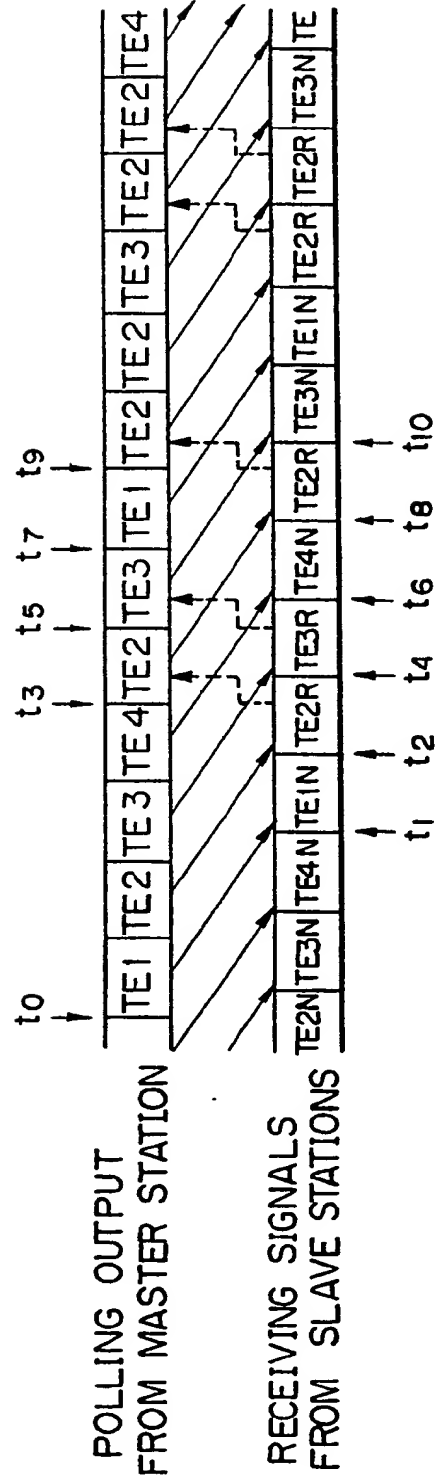


Fig. 5

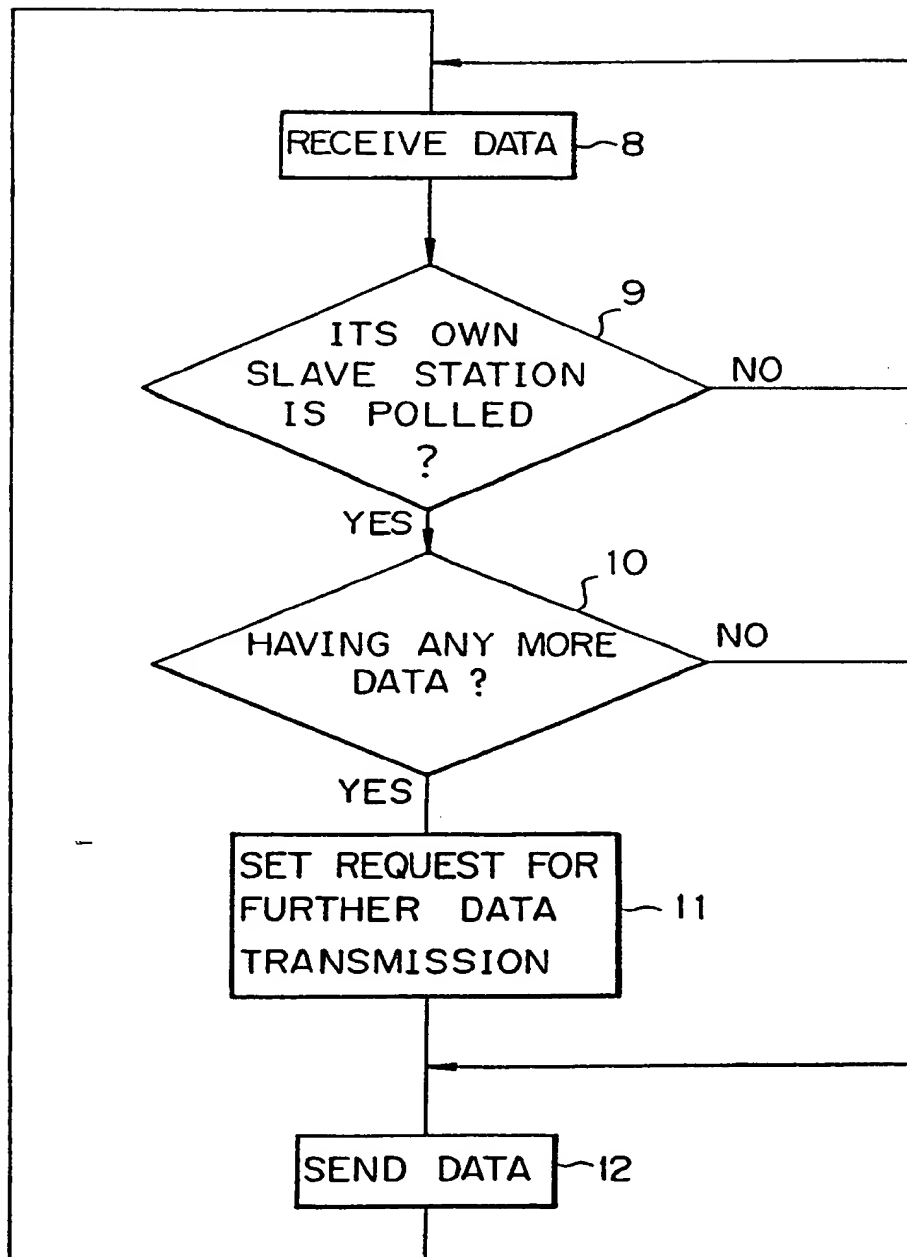


Fig. 6

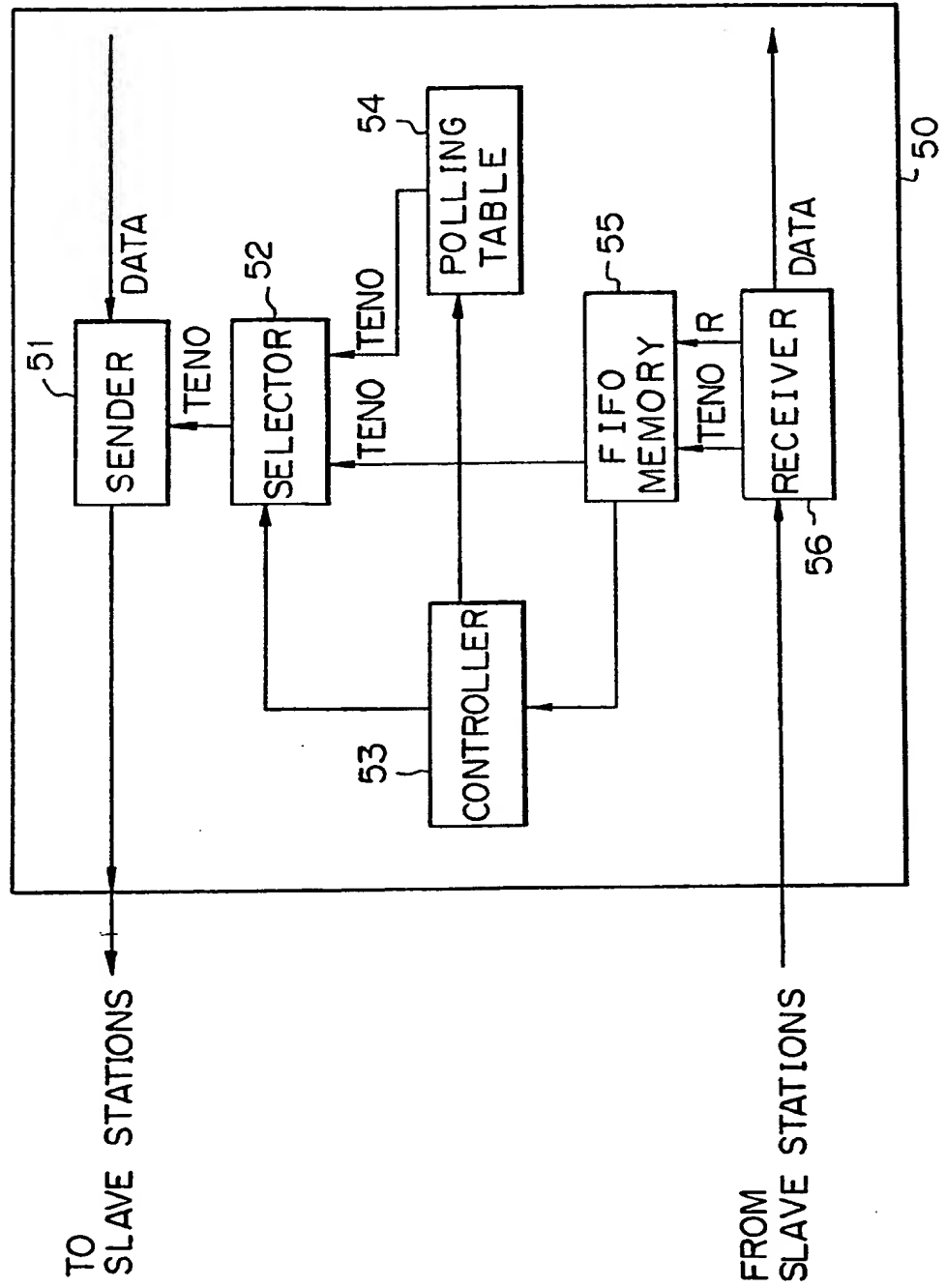


Fig. 7

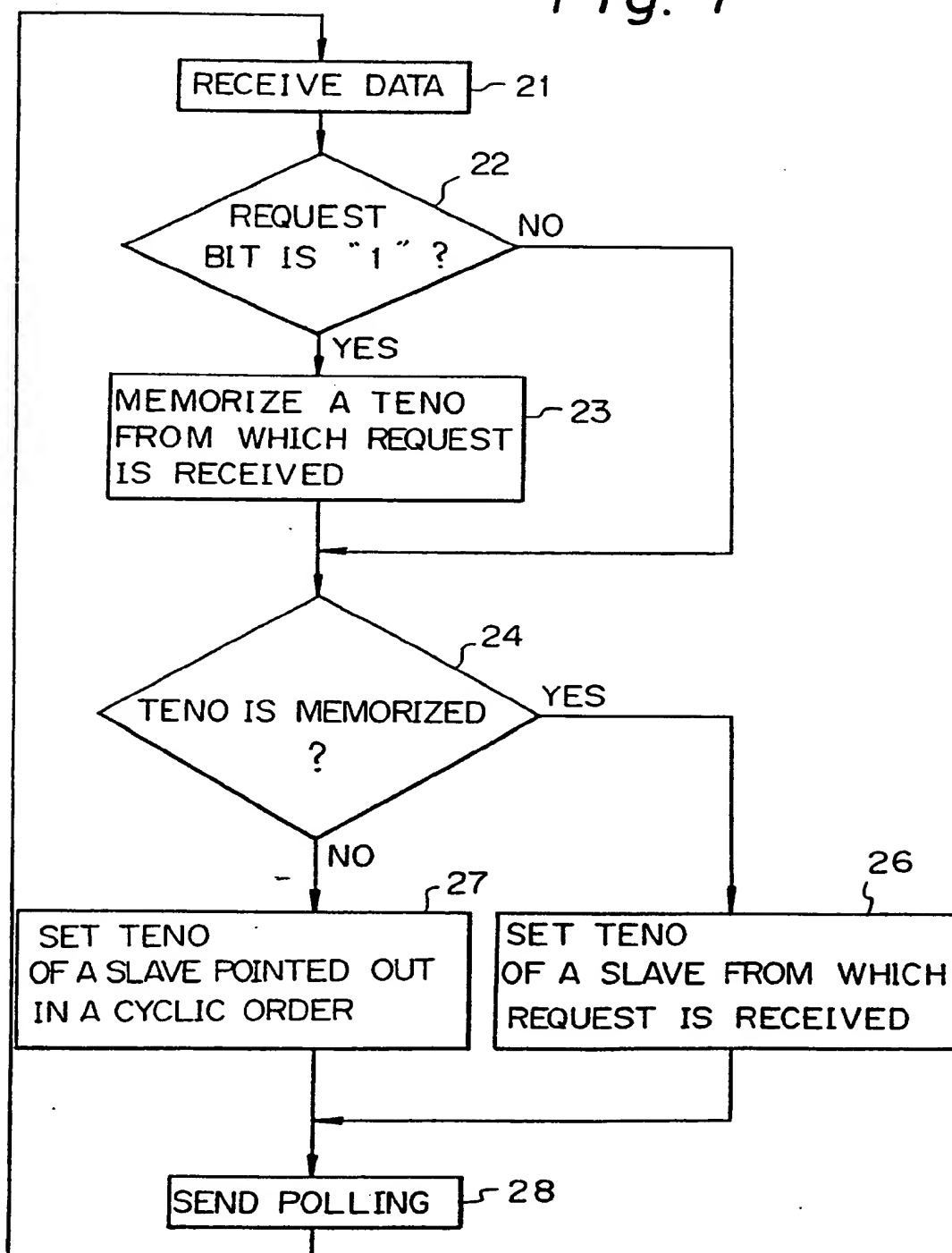


Fig. 9

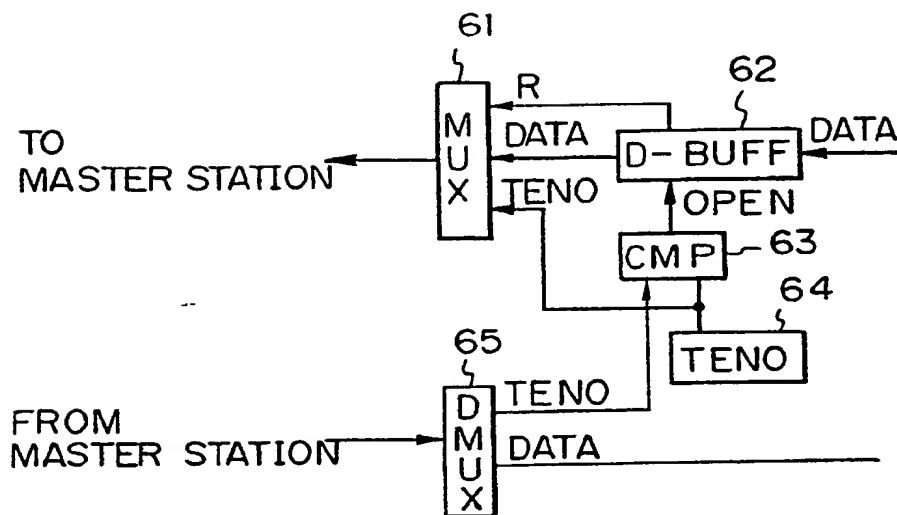


Fig. 10

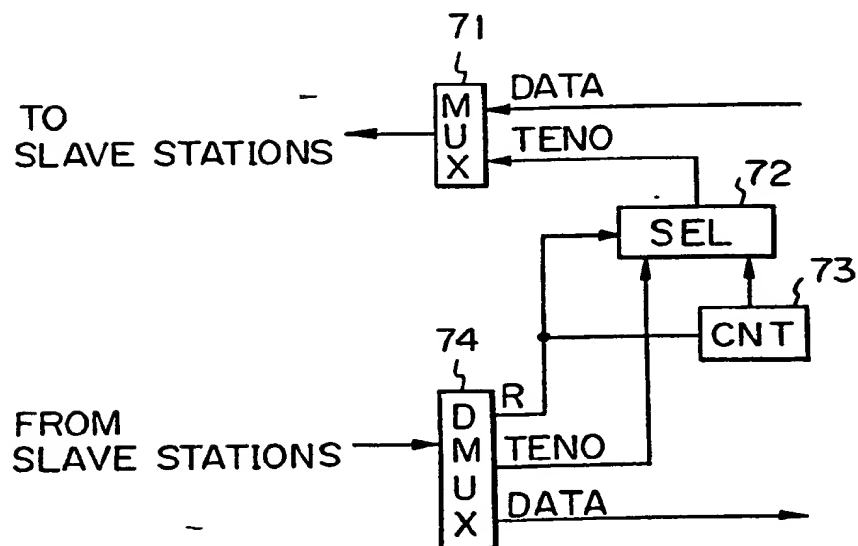


Fig. 11

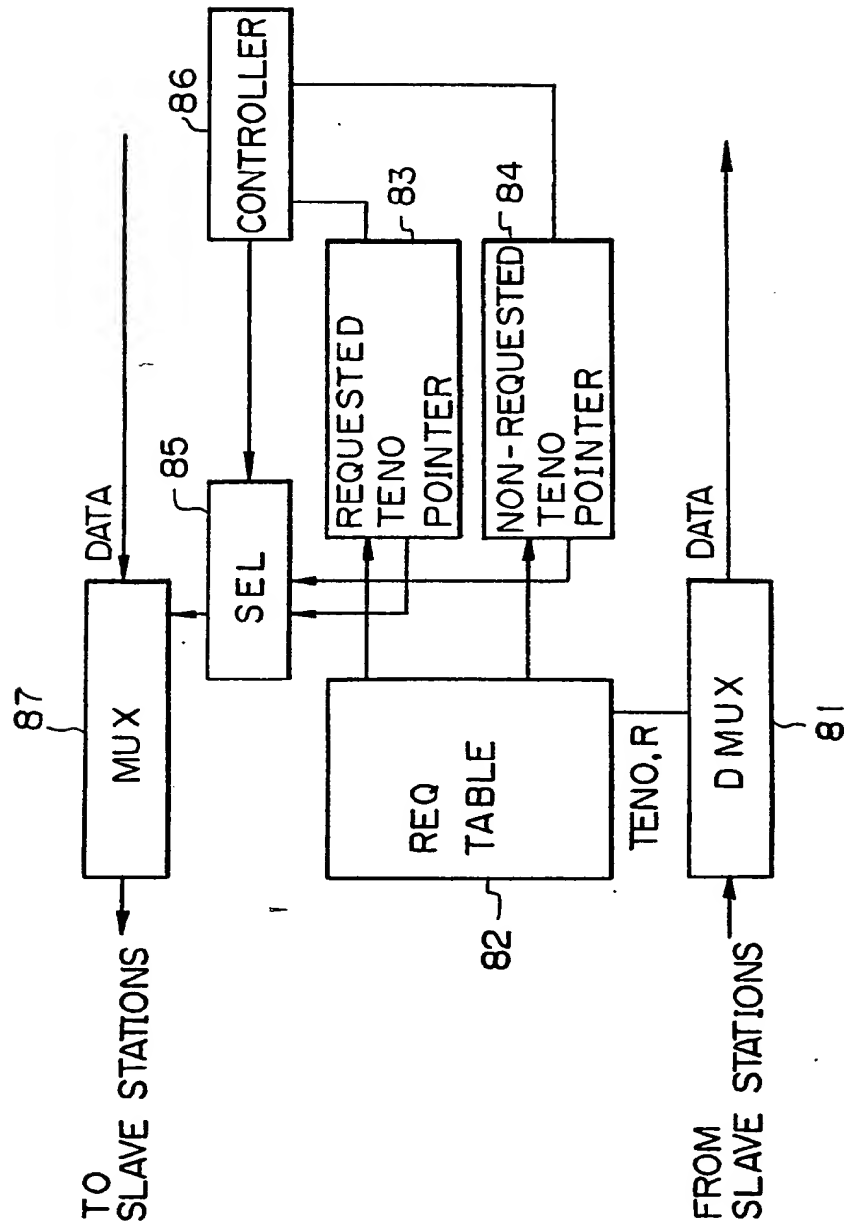


Fig. 12

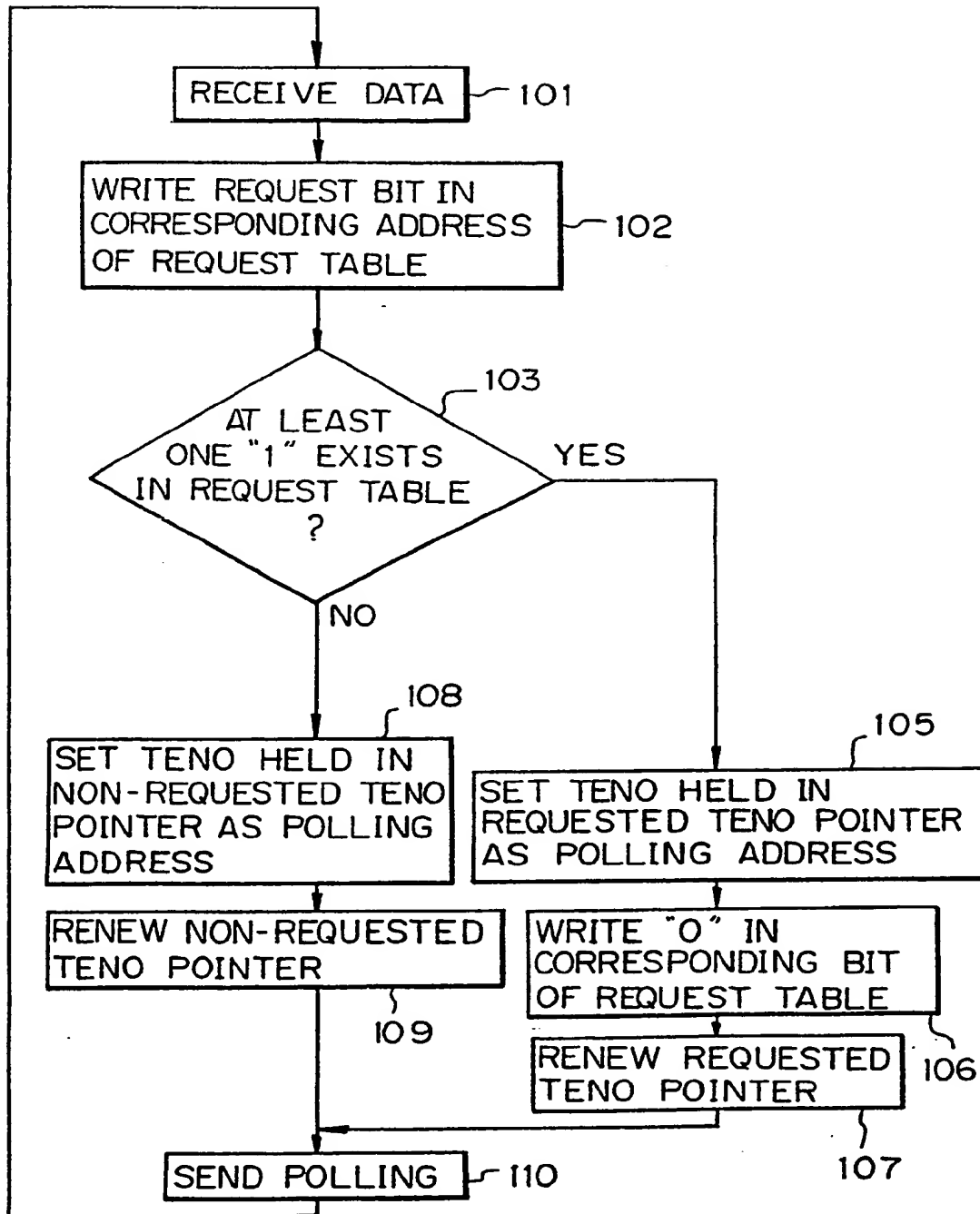


Fig. 13

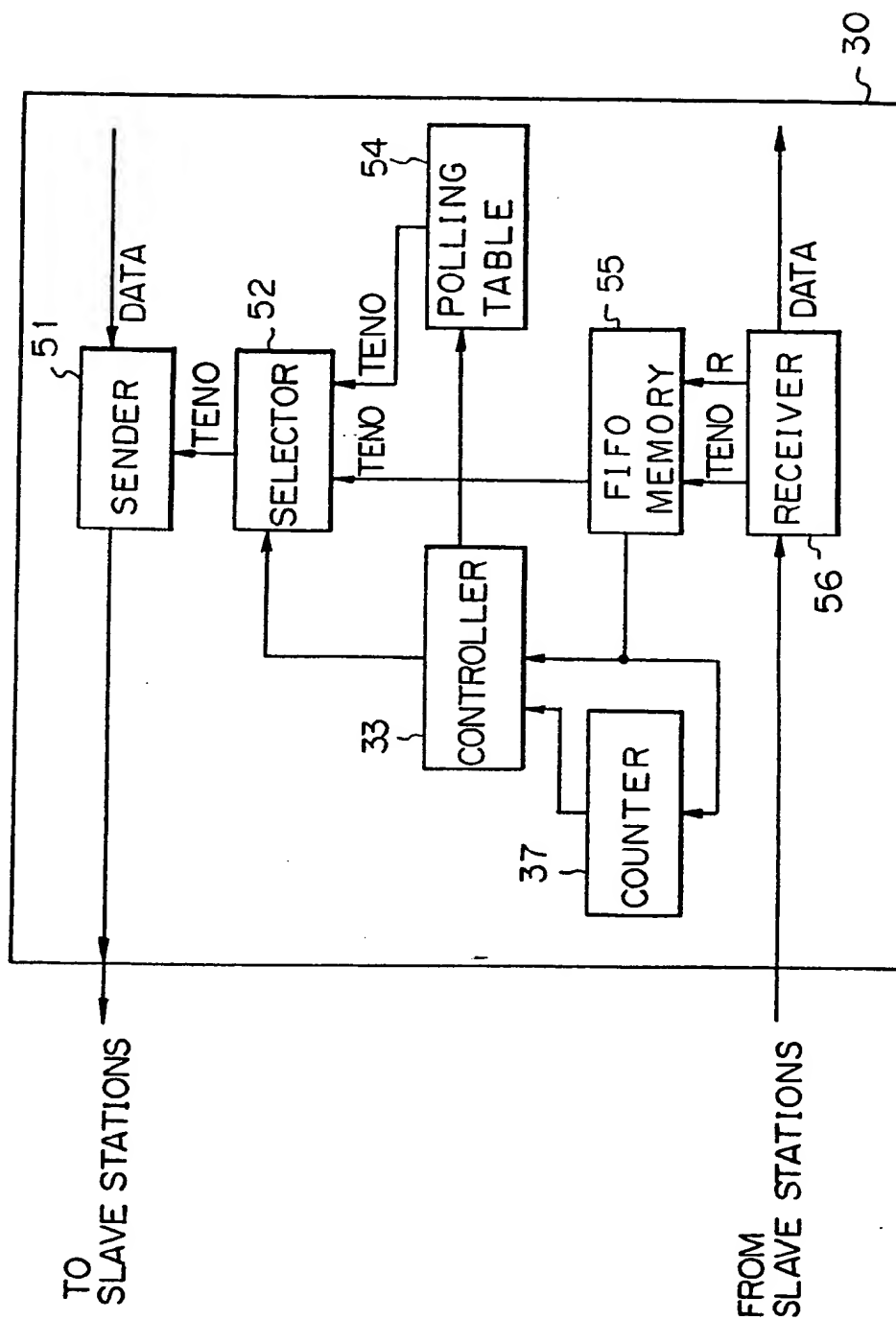


Fig. 14

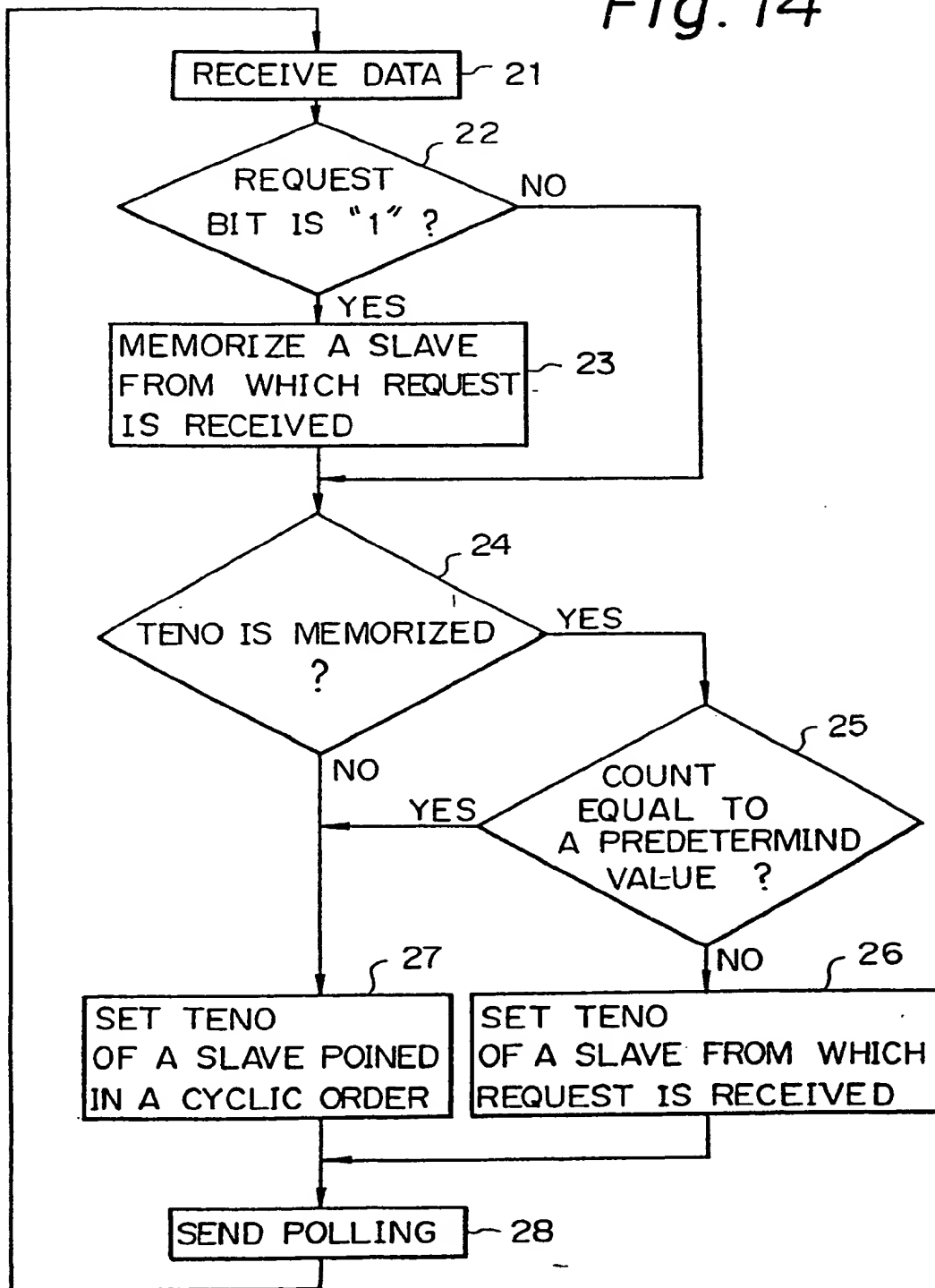


Fig. 15

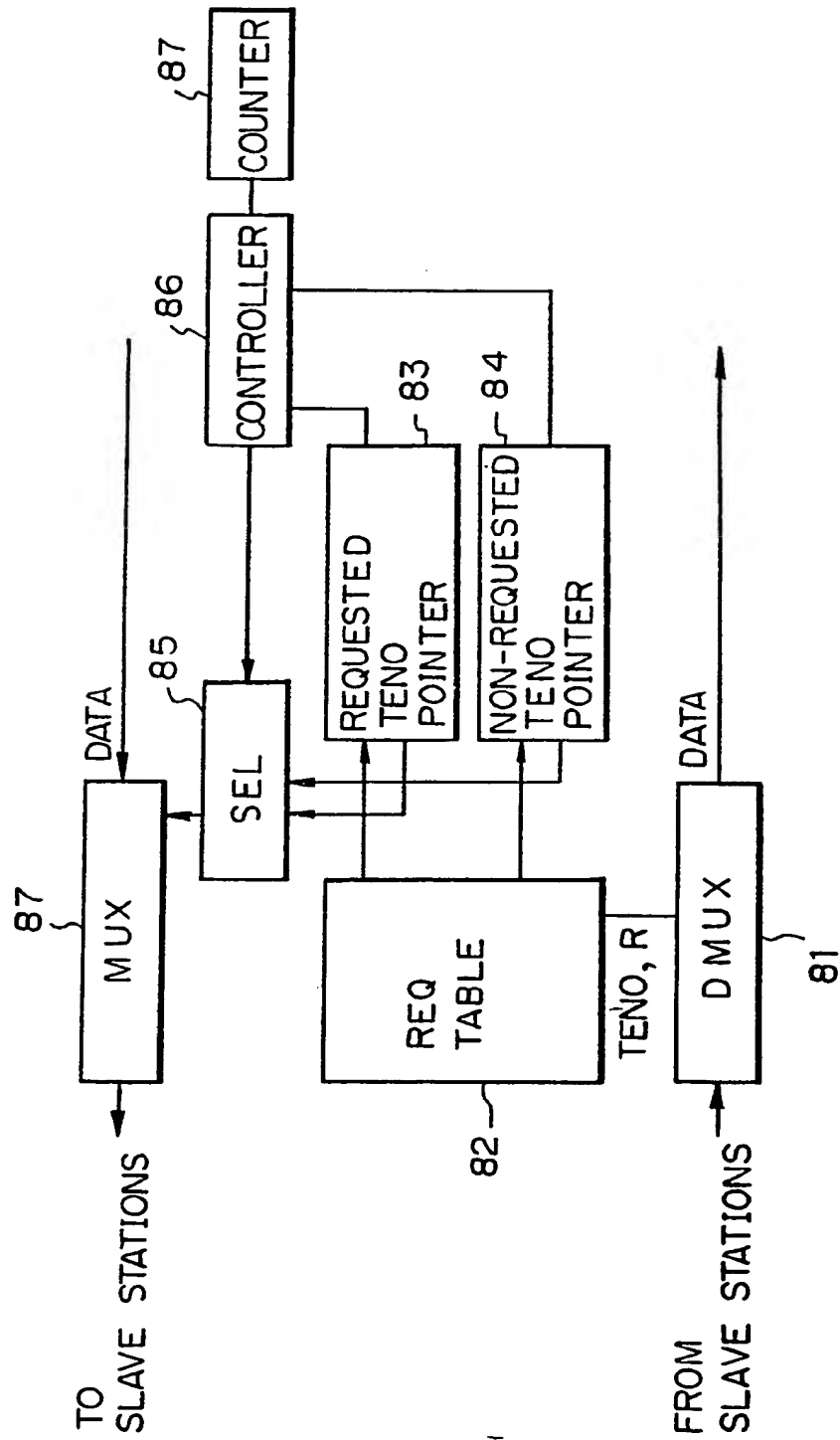
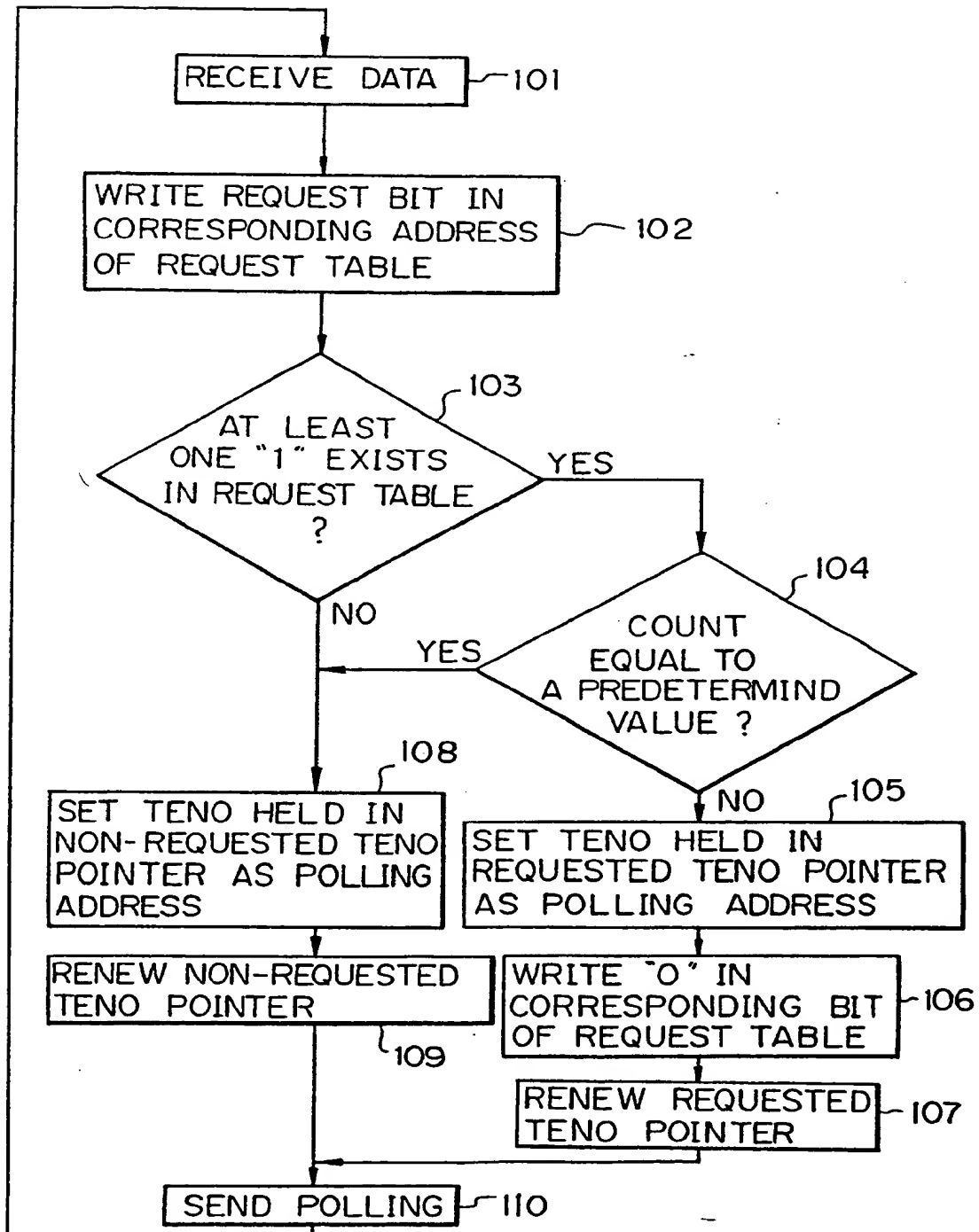


Fig. 16





Publication number:

0 372 567 A3

12

EUROPEAN PATENT APPLICATION

21 Application number: 89122681.3

51 Int. Cl.⁵: H04L 12/40, H04L 29/02

22 Date of filing: 08.12.89

30 Priority: 09.12.88 JP 310100/88

43 Date of publication of application:
13.06.90 Bulletin 90/24

64 Designated Contracting States:
DE FR GB

68 Date of deferred publication of the search report:
06.03.91 Bulletin 91/10

71 Applicant: **FUJITSU LIMITED**
1015, Kamikodanaka Nakahara-ku
Kawasaki-shi Kanagawa 211(JP)

72 Inventor: **Tezuka, Koji**
Fujitsu Dai 12 Nakahararyo 339-1,
Shimokodanaka
Nakahara-ku Kawasaki-shi Kanagawa 211(JP)

Inventor: **Shinomiya, Tomohiro**
 Coopo Hai Brijji 102 131-4, Imainishimachi
 Nakahara-ku Kawasaki-shi Kanagawa 211(JP)
 Inventor: **Amemiya, Shigeo**
 1-30-3-306, Kaminomiya Tsurumi-ku
 Yokohama-shi
 Kanagawa 230(JP)
 Inventor: **Iguchi, Kazuo**
 2582-8, Imajuku-cho Asahi-ku
 Yokohama-shi Kanagawa 241(JP)
 Inventor: **Soejima, Tetsuo**
 1-67-6-3, Suwa
 Tama-shi Tokyo 206(JP)

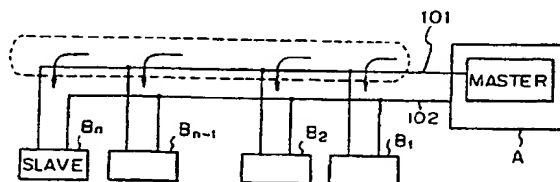
74 Representative: **Lehn, Werner, Dipl.-Ing. et al**
Hoffmann, Eitle & Partner Patentanwälte
Arabellastrasse 4
W-8000 München 81(DE)

54 Polling communication system with priority control.

57 A communication system containing: a master station (A), a plurality of slave stations (B1, B2, ... Bn-1, Bn) each for communicating with the above master station (A), a two-way transmission line (101, 102) connecting the above master station (A) and the above plurality of slave stations (B1, B2, ... Bn-1, Bn). Each of the above slave stations (B1, B2, ... Bn-1, Bn) sends a request for a further communication with the above master station (A), to the master station (A) when its own slave station is allowed to communicate with the master station (A) and its own slave station has the above request. The above master station (A) detects the request for a further communication with the above master station (A) in a signal sent from a slave station, and memorizes a slave station from which a request for a further communication with the master station (A) is detected, until an allowance is sent to the slave station from the master station (A) corresponding to the memorizing of the slave station. The master station (A) has a cyclic address pointer (54) which points

out an address of a next one of the above slave stations (B1, B2, ... Bn-1, Bn) in a cyclic order when no slave station is memorized in the master station (A). The master station (A) outputs an allowance to communicate with the master station (A): to a slave station which is memorized in the master station (A); or to a slave station the address of which is pointed out by the above cyclic address pointer (54) when no request is memorized in the master station (A).

Fig. 1





European
Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 89 12 2681

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
Y,A	US-A-4 742 512 (F. AKASHI ET AL.) * abstract ** column 1, lines 27 - 53 @ column 5, line 9 - column 7, line 63 * - - -	1,2-10	H 04 L 12/40
Y,A	US-A-3 702 008 (G.S. GROTH) * abstract ** column 2, lines 23 - 64 ** column 5, lines 1 - 26 * - - -	1,2,6,7	
A	GB-A-2 162 722 (MESSERSCHMITT-BOLKOW-BLOHM GMBH) * abstract ** page 1, lines 85 - 94 ** page 2, lines 6 - 122 * - - -	1-10	
A	WO-A-8 600 733 (NCR CORPORATION) * page 1, line 33 - page 3, line 8 ** page 8, line 33 - page 10, line 10 * - - - - -	1-10	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			H 04 L G 06 F
Place of search		Date of completion of search	Examiner
The Hague		14 January 91	STAESSEN B.F.
<div><div>CATEGORY OF CITED DOCUMENTS X: particularly relevant if taken alone Y: particularly relevant if combined with another document of the same category A: technological background O: non-written disclosure P: intermediate document T: theory or principle underlying the invention</div><div>E: earlier patent document, but published on, or after the filing date D: document cited in the application L: document cited for other reasons &: member of the same patent family, corresponding document</div></div>			

**This Page is Inserted by IFW Indexing and Scanning
Operations and is not part of the Official Record**

BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

- ☐ **BLACK BORDERS**
- ☐ **IMAGE CUT OFF AT TOP, BOTTOM OR SIDES**
- ☒ **FADED TEXT OR DRAWING**
- ☐ **BLURRED OR ILLEGIBLE TEXT OR DRAWING**
- ☐ **SKEWED/SLANTED IMAGES**
- ☐ **COLOR OR BLACK AND WHITE PHOTOGRAPHS**
- ☐ **GRAY SCALE DOCUMENTS**
- ☐ **LINES OR MARKS ON ORIGINAL DOCUMENT**
- ☐ **REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY**
- ☐ **OTHER:** _____

IMAGES ARE BEST AVAILABLE COPY.

As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.